Appendix D

Air Emissions Modeling and Data Output

Appendix D

Air Emission Modeling Results for the Waste Area Group 1, Test Area North Operable Unit 1-10 Group 2 Sites Remedial Action

D-1. INTRODUCTION

This appendix presents the assumptions and calculations used for, and findings from, the evaluation of emissions of radionuclides and volatile organic compounds (VOCs) that could result from the planned removal of the V-Tank wastes and affected soils in the excavation area (EA) located at Test Area North at the Idaho National Engineering and Environmental Laboratory (INEEL). The excavation area includes the area of concern immediately surrounding the V-Tanks and piping, as well as the controlled area. The purpose of this evaluation is to determine if the planned removal and soil remediation activities will produce emissions to the atmosphere that could exceed the National Emissions Standards for Hazardous Air Pollutants (NESHAP) or Idaho Administrative Procedures Act (IDAPA) requirements for toxic air pollutants. The evaluation also addresses exposure to VOCs that workers, involved in the processing of V-Tank liquids and sludges, could incur. The evaluation addresses three different emission sources: radionuclides emitted during the excavation and handling of contaminated soils, radionuclide emissions during the processing of V-Tank wastes, and VOCs released to the atmosphere during the processing of V-Tank wastes. The three emission scenarios, their general characteristics, the contaminants of concern for each, and the emission and air dispersion models used to assess their impacts are summarized in Table D-1. Each evaluation is discussed further in the following sections.

D-1.1 Radionuclides from Soils during Remediation

During the remediation of soils in the V-Tanks excavation area, radionuclides may be emitted to the atmosphere as a result of excavation and material (i.e., soil) handling and from vehicle activities. The evaluation is based on the following conservative assumptions:

1. All soils in the excavation area are contaminated at the maximum concentrations reported in Appendix H of this *Comprehensive Remedial Design/Remedial Action Work Plan for the Test Area North, Waste Area Group 1, Operable Unit 1-10, Group 2 Sites (Draft)*, October 2001 (henceforth the RD/RA WP). Those concentrations are:

    a. Co-60: 610 pCi/g

    b. Cs-137: 54,120 pCi/g

    c. Sr-90: 1,110 pCi/g.

    Sr-90 was not actually detected in the V-Tank vicinity soils. However, gross beta was detected at 1,110 pCi/g in the V-Tank vicinity soils, and Sr-90 was included in the emission and dose assessment as a proxy for the gross beta. Additionally, although not reported, Ba-137M (Note: M indicates meta stable) was included as a Cs-137 decay product at 95% of the Cs-137 concentration: 51,414 pCi/g.

2. The quantity of contaminated soil in the excavation area is assumed to be approximately 3,950 yd^3 based on engineering estimates. This is the total quantity of soil that is capable of being emitted as dust and includes 1,250 yd^3 in the immediate area of the tanks and piping, 2,200 yd^3 of soil adjacent to the area of the tanks and piping, and 500 yd^3 of fill material that will be used during the actual excavation[1]. Although highly conservative, this quantity (3,950 yd^3 or 5,919 ton [(3,950 yd^3 × 27 ft^3 per yd^3 × 111 lb per ft^3)/ 2,000 lb per ton)]) will be used as a worst-case estimate for the NESHAP compliance assessment. Additionally, it is assumed that no mitigative actions such as dust suppression or enclosures are used.

3. It is assumed that soils are emitted to the atmosphere as dust. Radionuclides affixed to the dust are transported via the wind to the nearest fence line, which is approximately 12,000 m away to the northeast (NE). Release to the atmosphere occurs as a result of two mechanisms that may occur during remediation:

   a. Aggregate handling of the soils, such as from a front-end or similar loader. Aggregate handling is assumed to occur twice: first from the excavation to a stockpile, then again from the stockpile to bags. Thus, the actual quantity of soil subject to the emission estimations is 7,900 yd^3 (11,838 ton).

   b. Dust generated from vehicle tires (e.g., front-end loader) as they operate in the excavation area. For estimating emission, it is assumed that a vehicle could travel 9.5 miles overall within the excavation area during the course of the excavation.

4. Atmospheric dispersion was simulated using meteorological data for the Pocatello, Idaho, airport provided with CAP-88, assuming a 3-m release height for the loader operation and ground-level release for dust generated from vehicle tires.

5. The source area for CAP-88 was the entire area of the excavation area (390 m^2), which includes the immediate area of the tanks and piping (115 m^2) and the controlled area adjacent to the area of the tanks and piping (275 m^2).

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1. Additional information on the quantities, volumes, densities, and areas of the soils, as well as similar information for the liquids, sludges, and sand filter, is presented in the tables in Section D-3.3.3. Additionally, details of the computations and examples are provided in Section 3.

Table D-1. Summary of Air Modeling Evaluation.

Source	Description	Contaminants of Concern	Air Emission and Dispersion Models
Radionuclides from soils	During the remediation of soils in the V-Tanks EA, radionuclides may be emitted from excavation, material handling, and from vehicle activities. Maximum radionuclide concentrations will be used along with conservative assumptions to evaluate the impacts at the maximally exposed individual (MEI).	Co-60 Cs-137 Ba-137M Sr-90	Emissions computed with standard air pollution factors from AP-42 (EPA 1998). Dispersion and dose estimates computed with CAP-88 (EPA 1997).
Radionuclides from sludges and the sand filter	During removal of the V-Tank contents, radionuclides may be emitted from the handling and processing activities. Maximum radionuclide concentrations will be used along with conservative assumptions to evaluate the impacts at the MEI. The results will be very conservative since the materials removed from the V-Tanks will be sludges and liquid, the process will be within a closed system, and radionuclides are not expected to volatilize.	Co-60 Cs-137 Ba-137M Ni-60 Sr-90 Y-90	Emissions computed with standard air pollution factors from AP-42 (EPA 1998) with an engineering modification. Dispersion and dose estimates computed with CAP-88 (DOE 1997).
VOCs from the V-Tank liquids and sludges	During removal of the V-Tank contents, VOCs may be emitted from the handling and processing activities. Maximum VOC concentrations will be used along with conservative assumptions to evaluate the impacts to workers in the immediate vicinity of the tanks, and to the offsite public at the MEI location.	Trichloroethene Tetrachloroethene 1,1,1-Trichloroethane	Emissions computed with modified air pollution factors from AP-42 (EPA 1998). Dispersion and concentration estimates computed using a simple box model (Dobbins 1979) and the Chi/Q relationship developed with CAP-88 (DOE 1997).

D-1.2 Radionuclides from Sludges and the Sand Filter

The materials removed from the V-Tanks will be sludges and liquids, and the process will generally be within a closed piping system. Individual V-Tanks and containers used in the process, however, may be open to the atmosphere for short periods of time. Although the radionuclides are not volatile, it is remotely possible that radionuclides could be emitted from the handling and processing activities during removal of the V-Tank contents. Additionally, it is possible that the sludges could be released to the environment from a spill, piping rupture, or other event, resulting in a loss of containment. The evaluation of the effects for this type of event is based on the following conservative assumptions:

1. The inventory of radionuclides available for release to the atmosphere assumes that all sludges in the four tanks, and the solids or "shake" from the sand filter, are contaminated at their maximum concentrations reported in Appendix H of the RD/RA WP. Those concentrations are reported in Table D-2. It should be noted that the radionuclides in the sludge would not be easily emitted to the atmosphere. They will likely be in ionic solution with the water phase of the sludge, complexed with other solids (i.e., the sediment phase), or precipitated as part of the sediment phase. Radionuclides in the solid phase will likely be submerged owing to the higher density of the solid phase. The radionuclides listed in Table D-2 represent over 99% of the activity reported in the four tanks and the sand filter (Appendix H). Other radionuclides reported in the sludge, such as the alpha emitting actinides plutonium, uranium, americium, and europium (a beta emitter) will not be included in the emissions inventory because they constitute less than 0.2% of the total activity in the sludge and sand filter. Thus, utilizing the radionuclides and concentrations reported in Table D-2 as a basis for dispersion, modeling will significantly overestimate the CAP-88 results and any related NESHAP compliance assessment and reporting. This assertion has been confirmed through a screening-level CAP-88 simulation using maximum sludge and sand filter concentrations. The results of that simulation indicate that the dose associated with Pu-238 and Pu-239/240 is approximately 2E-9 mrem/y, which is very small (about 0.0003%) compared to the total dose of 6.5E-4 mrem/y from all sources associated with the V-Tanks and sand filter remedial action (dose assessment results are detailed in Section D-2.1).

2. The total quantity of contaminated solids (i.e., the sludge and shake from the sand filter), based on engineering estimates using quantities provided in Section 6 of the RD/RA WP was assumed to be 16,594 lb (~8.3 tons; see the Tables in Section D-3.3.3).

3. For modeling purposes, it is assumed that the solids are released to the atmosphere as dust (even though they will actually be wet) and emissions to the atmosphere are unlikely. Radionuclides affixed to the dust are transported via the wind to the nearest fence line, which is approximately 12,000 m away to the NE. Release to the atmosphere occurs as a result of resuspension, as might occur from aggregate handling similar to processing with a front-end loader. Since the sludges will actually be handled in a closed piping system and if they are released to the atmosphere (e.g., a spill), they will be wet, it is assumed that only 10% of the total inventory are actually available for release to the atmosphere. A simple and conservative engineering judgment was made to modify the emission calculation to express, in a cautious manner, the effect of the enclosed piping process and the wet characteristic of the materials. In all likelihood, there will be no emissions of radionuclides from the process piping should a spill occur; the high moisture content of the sludge will prevent emission of radionuclides on dust particles.

4. The source area for CAP-88 was 116 m^2, which is the immediate area of the tanks and piping (i.e., 115 m^2) rounded up.

5. Atmospheric dispersion was simulated using meteorological data for the Pocatello, Idaho, airport provided with CAP-88 assuming ground-level release.

D-1.3 VOCs from V-Tank Liquids and Sludges

The materials removed from the V-Tanks will be sludges and liquids. The process will take place within a closed system. Some of the chemicals reported in the tank liquids are volatile and, during removal of the V-Tank contents, it is possible that the VOCs may be emitted from the handling and processing activities. Additionally, it is possible that the VOCs could be released to the atmosphere from a spill, piping rupture, or other event resulting in a loss of containment. The evaluation of the effects for this type of event is based on the following conservative assumptions:

1. The inventory of VOCs available for release to the atmosphere assumes that all liquids in the four tanks are contaminated at the maximum concentrations reported in Appendix H of the RD/RA WP. Those concentrations are reported in Table D-3.

2. Based on estimates from Section 6 of the RD/RA WP, the estimated total quantity of sludges and liquids is 11,899 gallons.

3. For modeling purposes, the VOCs are assumed to be released to the atmosphere as volatile compounds based on their comparatively high vapor pressures. Release to the atmosphere is assumed to occur as a result of evaporation as might result from cleaning tank cars or drums. Based on AP-42 (EPA 1998), evaporative losses of pure tetrachloroethene from cleaning tank cars can approximate ~ 0.22% of the total. The three principal VOCs (trichloroethene, tetrachloroethene, and 1,1,1-trichloroethane), when summed, represent a maximum concentration of approximately 6.0%. Thus, a simple and conservative fraction of 0.00013 (0.0022 * 0.06) of the total inventory (liquids and sludges) was assumed for the three VOCs.

Table D-2. Radionuclide Concentrations Assumed for the Sludge and Sand Filter Inventory.

Radionuclide	Tank V-1 (pCi/g)	Tank V-2 (pCi/g)	Tank V-3 (pCi/g)	Tank V-9 (pCi/g)	Sand Filter (pCi/g)
Co-60	446,000	705,000	321, 000	1,160,000	36,200
Cs-137	15,800,000	14,100,000	13,200,000	6,370,000	109,000
Ba-137M [a]	15,010,000	13,395,000	12,540,000	6,051,500	103,550
Ni-63	3,310,000	1,750,000	1,770,000	NR[b]	NR[b]
Sr-90	14,300,000	16,500,000	44,500,000	7,070,000	103,000
Y-90 [c]	14,300,000	16,500,000	44,500,000	7,070,000	103,000

Notes:

1. Co-60, Cs-137, Ba-137M, Ni-63, Sr-90, and Y-90 represent over 99% of the activity in these sludges and solids.

2. Daughter product ratios were computed using *RadDecay* (Grove Engineers 1995)

a. Ba-137M is the short-lived meta stable daughter of Cs-137. It is assumed to be ~ 95% of the Cs-137 concentration.

b. NR = not reported

c. Y-90 is the daughter of Sr-90. It is assumed to be ~ 100% of the Sr-90 concentration.

Table D-3. VOC Concentrations Assumed for Inventory.

Liquids				
VOC	Tank V-1 μg/L	Tank V-2 μg/L	Tank V-3 μg/L	Tank V-9 μg/L
Trichloroethene	160	300	200	410,000
Tetrachloroethene	140	ND	ND	ND
1,1,1-Trichloroethane	ND	ND	ND	58,000
Solids (Sludges)				
VOC	Tank V-1 mg/kg	Tank V-2 mg/kg	Tank V-3 mg/kg	Tank V-9 mg/kg
Trichloroethene	23	5.9	36	22,000
Tetrachloroethene	1,800	541	480	600
1,1,1-Trichloroethane	ND	ND	ND	2,600

1. These three chemicals (trichloroethene, tetrachloroethene, and 1, 1, 1-trichloroethane) represent over 99% of the VOC mass in the V-Tank sludges.

2. ND = Not Detected

Once emitted, the VOCs are transported via the wind to the nearest fence line, which is approximately 12,000 m away to the NE. Additionally, VOC exposure point concentrations are estimated to evaluate worker exposures in the near vicinity of the V-Tanks and processing equipment.

4. Atmospheric dispersion was simulated using the Chi/Q (Chi over Q) relationships developed for the ground level release of radionuclides from the sludges and sand filter discussed in Section D-1.2 using CAP-88. This approach utilizes meteorological data for the Pocatello, Idaho, airport to disperse the VOCs to the maximally exposed individual using the same algorithms as used before. The Chi/Q value used in these calculations, 6.2E-8 sec/m^3, is for the NE vector at a distance of 12,000 meters.

Worker exposure point concentrations were estimated using a simple and conservative box model. Conceptually, the box model functions as a tent or “box” over the V-Tanks so that vapor concentrations can be computed and compared with Occupational Safety and Health Administration (OSHA) permissible exposure limits (PELs).

D-2. RESULTS

The results for each evaluation are presented in this section.

D-2.1 Results of Radionuclide Emission Modeling

The results for the radionuclide emission modeling are presented in Table D-4. To facilitate regulatory analysis, the table also presents the NESHAP regulatory requirement for radionuclides, which is 10 mrem/y from all INEEL sources. Inspection of the table indicates that both sources of radionuclide emissions combine to produce an effective dose equivalent (i.e., dose) of 6.5 E-4 mrem/y (see Table D-4), which is more than fifteen thousand times below the NESHAP requirements of 10 mrem/y. Readers should note that the NESHAP requirements are intended to govern all INEEL sources combined. Thus, air emissions from the removal, treatment, and disposal of the V-Tank wastes are expected to contribute a very small amount to the overall INEEL allocated dose limit. It is important to bear in mind the conservatism embodied in these dose estimates, particularly the radionuclides from sludges and the sand filter component, as well as the conservative volume of soils assumed for the soil emission estimations. It is probable that the doses presented in Table D-4 overstate the actual doses by a factor of ten or more. In all likelihood, removal, treatment, and disposal of the V-Tank wastes will not produce any discernable dose to an offsite receptor.

Table D-4. Results of Radionuclide Emission Modeling.

Emission Source	Estimated MEI Dose [a] (Located at the NE Fence Line)	NESHAP Requirement [b] (All INEEL Sources)
Radionuclides from soils	6.5E-4 mrem/y	
Radionuclides from sludges and the sand filter	8.3E-8 mrem/y	**10 mrem/y**
Total	**6.5E-4 mrem/y**	

a. This is the effective dose equivalent (EDE).

b. 40 CFR Part 61 limits the INEEL to 10 mrem/y from all sources.

D-2.2 Results of VOC Emission Modeling

The results for the VOC emission modeling to the fence line are presented in Table D-5. The table also presents the IDAPA regulatory requirement for each VOC.

Table D-5. Results of VOC Emission Modeling to the Fence Line

VOC	Estimated Fence Line Concentration	IDAPA Requirement
Trichloroethene	9.9E-11mg/m^3	7.7E-4 mg/m^3 [a]
Tetrachloroethene	3.0E-11mg/m^3	2.1E-3 mg/m^3 [a]
1,1,1-Trichloroethane	1.3E-13 mg/m^3	95.5 mg/m^3 [b]

a. These are IDAPA average annual acceptable ambient concentrations for carcinogens (AACCs) (IDAPA 2001).

b. This is the IDAPA acceptable ambient concentration (AAC) for the non-carcinogenic 1,1,1- trichloroethane, also known as methyl chloroform (CAS No. 71-55-6) (IDAPA 2001).

Inspection of the table indicates that concentrations of both trichloroethene and tetrachloroethene, estimated at the nearest fence line, are far below their respective IDAPA regulatory requirements. Moreover, IDAPA's requirements for these compounds are ambient air average annual (365-day) concentrations, and the V-Tank waste processing is expected to last approximately 60 days. In essence, the estimated concentrations in Table D-5 are 60-day averages. Consequently, for trichloroethene and tetrachloroethene there is an additional safety factor of 6 (60/365) in the Table D-5 comparisons.

The IDAPA acceptable ambient concentration for 1,1,1-trichloroethane is 95.5 mg/m^3. As indicated, the estimated fence line concentration of 1.3×10^{-13} mg/m^3 is many orders of magnitude below the regulatory requirement. The results and comparisons obtained from Table D-5 further indicate that processing the V-Tank wastes can be accomplished without challenging IDAPA's requirements for toxic air pollutants.

The results for the VOC emission estimation and worker exposure modeling are presented in Table D-6. The table also presents the IDAPA emission rate screening limit requirements for each VOC emission, as well as the applicable OSHA PEL.

Table D-6. Results of VOC Emission Estimations and Worker Exposure Modeling.

VOC	Emission Rate (lb/hr)	IDAPA Requirement[a] (lb/hr)	Worker Exposure Concentration (mg/m^3)	OSHA PEL[b] (mg/m^3)
Trichloroethene	1.3E-5	5.1E-4	2.6E-5	5.4E+2
Tetrachloroethene	3.8E-6	1.3E-2	7.9E-6	6.8E+2
1,1,1-Trichloroethane	1.7E-9	1.3E+2	2.6E-8	1.9E+3

a IDAPA Screening Emission Limits (EL) from Sections 58.01.01,585 and 586 (2001)

b 29 CFR 1910.1000, Table Z-2 (OSHA 1997)

Inspection of Table D-6 illustrates that the conservatively estimated VOC emission rates are expected to be well below IDAPA screening emission limits. The VOC emission calculations were based on EPA's methods for cleaning rail cars and tank trucks using cleaning agents, such as water, steam, and detergents that are applied using steam hoses, pressure wands, rotating spray nozzles, and the like (EPA 1998). It is possible that compressed air may be used for processing the V-Tank materials. Although EPA does not explicitly mention compressed air in their AP 42 study (EPA 1998), it is considered reasonable that, given the examples cited, the estimation method is suitable for estimating emissions that could result from the use of compressed air as well.

In addition, worker exposure concentrations in the vicinity of the V-Tanks should not approach OSHA compliance limits.

D-3. EMISSION ESTIMATION COMPUTATIONS

The emission calculations used to develop the fence line and worker exposure estimates in the previous section are presented in the following sections.

D-3.1 Emissions of Radionuclides from Soils during Remediation

Emissions resulting from excavation, material handling, and vehicle activities during the remediation of soils in the V-Tanks excavation area are computed with two equations taken from AP-42, Section 13 (EPA 1998). They are given below:

$$E(\text{lb/ton}) = k(0.0032)\frac{\left[\frac{U}{5}\right]^{1.3}}{\left[\frac{M}{2}\right]^{1.4}} \qquad \text{(D-1)}$$

$$E(\text{lb/VMT}) = \frac{k \times \left(\frac{s}{12}\right)^{a} \times \left(\frac{W}{3}\right)^{b}}{\left(\frac{M}{0.2}\right)^{c}} \qquad \text{(D-2)}$$

Equation (D-1) estimates the pounds of dust emitted per ton of soil handled, and Equation (D-2) estimates the pounds of dust emitted per vehicle mile traveled (VMT). As discussed previously, maximum radionuclide soil concentrations were used to derive a conservative estimate of emission arising from soil remediation in the excavation area. Details and the parameters used in these equations are presented in Tables D-7 and D-8, respectively. The radionuclide emissions in pCi/year that were entered into CAP-88 can be found in **bold** text on the far right side of Table D-9 as the sum from both operations in the column headed **Ci**.

D-3.2 Radionuclides from Sludges and the Sand Filter

During removal of the V-Tank contents, radionuclides may be emitted from the handling and processing activities. Emissions are estimated using the same equation used for the excavation and material handling activities during the remediation of soils in the V-Tanks excavation area (Equation [D-1]) with an engineering modification to account for the facts that:

- The solids will actually be handled in a closed piping system and they are not likely to be released to any extent.
- The materials will be wet and they are not likely to be released to any degree.

The equation, modified from AP-42 (EPA 1998), is as follows:

$$E(\text{lb/ton}) = k(0.0032)\frac{\left[\frac{U}{5}\right]^{1.3}}{\left[\frac{M}{2}\right]^{1.4}} \times \text{EFactor} \qquad \text{(D-3)}$$

Table D-7. Emission Rates of Varying Particulate Matter Sizes.

Pickup and dropping emissions from excavation (lb/Ton)	PM-30	PM-15	PM-10	PM-5	PM-2.5	Sums, pCi	Sum Ci
E = emission factor (lb emitted/Ton handled)	$\boxed{0.00097}$	0.0006	0.00046	0.00026	0.00014	0.002	
Multiplier for handling twice	2.0	2.0	2.0	2.0	2.0	2.0	
lbs soil emitted (@ 5919 tons handled twice)	11.455	7.430	5.418	3.096	1.703	29.102	
grams soil emitted (@ 5919 tons handled twice)	5,201	3,373	2,460	1,406	773	13,212	
Co-60 emitted (pCi), (Csoil max = 610 pCi/g)	$\boxed{3,172,331}$	2,057,728	1,500,427	857,387	471,563	8,059,435	**8.1E-06**
Cs-137 emitted (pCi), (Csoil max = 54,120 pCi/g)	281,453,351	182,564,336	133,119,828	76,068,473	41,837,660	715,043,648	**7.2E-04**
Ba-137 emitted (pCi), (95% of Cs-137)	267,380,683	173,436,119	126,463,837	72,265,049	39,745,777	679,291,465	**6.8E-04**
Sr-90 emitted (pCi), (Csoil max = 1,110 pCi/g proxy value of gross beta)	5,772,602	3,744,390	2,730,285	1,560,163	858,089	14,665,529	**1.5E-05**
k = particle size multiplier (EPA 1998)	0.74	0.48	0.35	0.2	0.11		
U =mean wind speed (mph) (DOE 2000b)	8.2						
M = moisture content (%) (DOE 2000b)	6						
Constant	0.0032						
Equilibrium fraction of Ba-137M to Cs-137 =	0.95						
See example estimate of *E* for PM-30 below							
See Equation D-1							
Equation from EPA (1998)							
See example estimate of Co-60 in the PM-30 range below							
Note small rounding discrepancies							
Table D-13 summarizes volumes and quantities of soils							

$$E(0.00097\,\text{lb/ton}) = 0.74(0.0032)\frac{\left[\frac{8.2}{5}\right]^{1.3}}{\left[\frac{6}{2}\right]^{1.4}}$$

Example estimate of E for PM30 (See Table D-7 for comparison)

$$3{,}180{,}063\ \text{pCi} = \frac{0.00097\ \text{lb}}{\text{ton}} \times 2\ \text{handlings} \times 5{,}919\ \text{tons} \times \frac{454\ \text{g}}{\text{lb}} \times \frac{610\ \text{pCi}}{\text{g}}$$

Example estimate of CO-60 for PM30 (See Table D-7 for comparison)

Note small rounding discrepancy

Table D-8. Vehicle Emissions from Excavation (Dust from Vehicle Wheels).

Emissions from vehicle traffic within the AOC	PM-30	PM-15 [j]	PM-10	PM-5 [j]	PM-2.5	Sums	Sum Ci
E = emission factor (lb/VMT)	2.96	1.32	0.90	0.39	0.13	5.70	
lbs of soil emitted (@ 9.5 VMT)	28.2	12.6	8.6	3.7	1.3	54.4	
grams of soil emitted (@ 9.5 VMT))	12,813	5,702	3,916	1,687	572	24,691	
Co-60 emitted (pCi), (Csoil max = 610 pCi/g)	7,816,118	3478172.5	2389048.1	1029128.4	349168.6	15,061,636	**1.5E-05**
Cs-137 emitted (pCi), (Csoil max = 54,120 pCi/g)	693,456,247	308,588,030	211,959,478	91,305,621	30,978,693	1,336,288,069	**1.3E-03**
Ba-137 emitted (pCi), (95% of Cs-137)	658,783,434	293,158,628	201,361,504	86,740,340	29,429,758	1,269,473,665	**1.3E-03**
Sr-90 emitted (pCi), (Csoil max = 1,110 pCi/g proxy value of gross beta)	14,222,772	6,329,134	4,347,284	1,872,676	635,372	27,407,239	**2.7E-05**
k = particle multiplier (dimensionless)	10	4.5	2.6	1.1	0.38		
a	0.8	0.8	0.8	0.8	0.8		
b	0.5	0.5	0.4	0.4	0.4		
c	0.4	0.4	0.3	0.3	0.3		
VMT (excavation hours x mph)	9.5						
s = silt content % (from DOE 1998)	4.7						
S = mean vehicle speed (mph) (DOE 2000b)	0.1						
W = mean vehicle weight (tons) (DOE, 2000b)	17.85						
M = moisture content (%) (DOE 2000b)	6						
Tonnage to be excavated	5919						
Excavation rate, ton/hr (typical excavation, DOE 2000b)	62						
Excavation hours (tonnage / excavation rate)	95						

Example estimate of *E* for PM-30 below
See Equation D-2
Equation from EPA (1998)

Example estimate of Co-60 in the PM-30 range below

[j] PM-15 and PM-5 based on linear interpolation from PM-30 and PM-10, and PM-10 and PM-2.5, respectively
Table D-13 summarizes volumes and quantities of soils

$$E(2.96\,\mathrm{lb/VMT}) = \frac{10 \times \left(\frac{4.7}{12}\right)^{0.8} \times \left(\frac{17.85}{3}\right)^{0.5}}{\left(\frac{6}{0.2}\right)^{0.4}}$$

Example estimate of E for PM30 (See Table D-8 for comparison)

$$7{,}787{,}553\,\mathrm{pCi} = \frac{2.96\,\mathrm{lb}}{\mathrm{VMT}} \times 9.5\,\mathrm{VMT} \times \frac{454\,\mathrm{g}}{\mathrm{lb}} \times \frac{610\,\mathrm{pCi}}{\mathrm{g}}$$

Example estimate of CO-60 for PM30 (See Table D-8 for comparison)

Note small rounding discrepancy

Table D-9. Emission from Both Operations

Sum both operations	PM-30	PM-15	PM-10	PM-5	PM-2.5	pCi	**Ci** [a]
Co-60 emitted (pCi), (Csoil max = 610 pCi/g)	10,988,449	5,535,901	3,889,475	1,886,515	820,731	23,121,071	**2.3E-05**
Cs-137 emitted (pCi), (Csoil max = 54,120 pCi/g)	974,909,597	491,152,365	345,079,306	167,374,095	72,816,353	2,051,331,717	**2.1E-03**
Ba-137 emitted (pCi), (95% of Cs-137)	926,164,118	466,594,747	327,825,341	159,005,390	69,175,536	1,948,765,131	**1.9E-03**
Sr-90 emitted (pCi), (Csoil max = 1,110 pCi/g proxy value of gross beta)	19,995,374	10,073,524	7,077,569	3,432,839	1,493,462	42,072,768	**4.2E-05**

[a] Input to CAP 88

Table D-10. Emission Rates from Handling Wet Sludge Materials

Pickup and dropping emissions from excavation (lb/Ton)	PM-30	PM-15	PM-10	PM-5	PM-2.5	Sums	Sum Ci
*E** = emission factor (lb emitted/Ton handled)	$\boxed{2.2E-06}$	1.4E-06	1.0E-06	5.9E-07	3.2E-07	5.5E-06	
lbs sludge and filter shake emitted (@14.4 tons)	1.8E-05	1.2E-05	8.6E-06	4.9E-06	2.7E-06	4.6E-05	
grams soil emitted (@ 14.4 tons)	8.2E-03	5.3E-03	3.9E-03	2.2E-03	1.2E-03	2.1E-02	
Co-60 emitted (pCi), (max-total from V-tanks and sand filter = 5.6 E + 5 pCi/g	$\boxed{4.7E+03}$	3.0E+03	2.2E+03	1.3E+03	6.9E+02	1.2E+04	**1.2E-08**
Cs-137 emitted (pCi), (max-total from V-tanks and sand filter = 1.3 E + 7 pCi/	1.1E+05	7.1E+04	5.2E+04	2.9E+04	1.6E+04	2.8E+05	**2.8E-07**
Ni - 63 emitted (pCi), (max-total from V-tanks and sand filter = 1.9 E + 6 pCi/	1.6E+04	1.0E+04	7.6E+03	4.3E+03	2.4E+03	4.1E+04	**4.1E-08**
Sr - 90 emitted (pCi), (max-total from V-tanks and sand filter = 1.7E + 7 pCi/g	2.0E+05	1.3E+05	9.4E+04	5.4E+04	2.9E+04	5.0E+05	**5.0E-07**
Ba-137M (pCi), (95% of Cs-137 = 1.2 + E7)	1.0E+05	6.7E+04	4.9E+04	2.8E+04	1.5E+04	2.6E+05	**2.6E-07**
Y-90 (pCi), (100% of Sr- 90, 1.7E + 7)	2.0E+05	1.3E+05	9.4E+04	5.4E+04	2.9E+04	5.0E+05	**5.0E-07**
k = particle size multiplier EPA (1998)	0.74	0.48	0.35	0.2	0.11		
U =mean wind speed (mph) (DOE 2000b)	8.2						
M = moisture content (%), the materials will be wet (sludges)	90						
Constant	0.0032						
* E Factor = Enclosed system factor (conservative engineering judgment)	0.1						
Tons of sludge and filter shake handled	8.3						
Example estimate of *E* for PM-30 below							
See Equation D-3							
Equation modified from EPA (1998)							

Example estimate of Co-60 in the PM-30 range below

Note: The concentrations listed above are the maximum inventory of the four tanks and the sand filter / the total mass of the tanks and sand filter.
They are not the values reported in Table D-2. However, Table D-2 values were used to compute the maximum inventory for each tank and the sand filter.

Table D-14 summarizes volumes and quantities of liquids, sludges, and the sand filter

$$E(2.2E-6\ \mathrm{lb/ton}) = 0.74 \times (0.0032) \frac{\left[\frac{8.2}{5}\right]^{1.3}}{\left[\frac{90}{2}\right]^{1.4}} \times 0.1$$

Example estimate of E for PM30 (See Table D-10 for comparison)

$$4.6E+3\ \mathrm{pCi} = \frac{2.2E-6\ \mathrm{lb}}{\mathrm{ton}} \times 8.3\ \mathrm{tons} \times \frac{454\ \mathrm{g}}{\mathrm{lb}} \times \frac{5.6E5\ \mathrm{pCi}}{\mathrm{g}}$$

Example estimate of CO-60 for PM30 (See Table D-10 for comparison)

Note small rounding discrepancy

D-3.3 VOCs from the V-Tank Liquids

During removal of the V-Tank contents, VOCs may be emitted from the handling and processing activities. The VOCs can then be dispersed via advective wind currents. The equations used to estimate emissions and the dispersion computation are presented in this section.

D-3.3.1 Emission of VOCs from the Solid and Liquid Handling Process

A simple relationship derived from Section 4.8 of AP-42 (EPA 1998) for cleaning a tank truck was used to develop an emission factor for application to the inventory of VOCs in both the liquids and sludges. The conservative derivation for pure chemical product is found within the bracketed portion in Equation (D-4).

$$\text{Fraction Vocs Released} = [\frac{0.474 \text{ lb/truck}}{220 \text{ lb cleaned/truck}}] = 0.0022 \tag{D-4}$$

This emission factor, 0.0022, would actually overestimate the real V-Tank emissions because the equation was derived for pure or nearly pure chemicals. The VOCs in the V-Tanks are actually quite dilute. The three principal VOCs (trichloroethene, tetrachloroethene, and 1,1,1-trichloroethane) when summed could represent a maximum concentration of approximately 6.0%. Additionally, the VOCs are either in solution with the water, or they are adsorbed to the sludge material. Thus, they will not tend to volatilize as readily as the comparatively pure products used by the EPA in Section 4.8 of AP-42 (EPA 1998). Consequently, an additional factor of 6% will be used in Equation (D-4) to characterize the fraction of VOC released from the tanks and processing equipment. This modified emission fraction factor is presented below in Equation (D-5).

$$\text{FractionVocs Released} = [\frac{0.474 \text{ lb/truck}}{220 \text{ lb cleaned/truck}}] \times 0.06 = 1.3\text{E}-4 \tag{D-5}$$

The factor for the fraction of VOCs released is then applied to the inventory of VOCs processed and divided by the processing period to obtain an emission rate, as illustrated by Equation (D-6).

$$\text{mg/second} = 1.3\text{E}-4 \times \frac{\text{VOC processing inventory (mg)}}{\text{VOC processing period (seconds)}} \tag{D-6}$$

D-3.3.2 Estimation of Fence-Line VOC Concentrations

The Chi/Q relationship is commonly used to conservatively estimate steady state air concentrations at a location some distance from an emission source (EPA 1970). The Chi/Q factor, in units of sec/m^3, relates the effects of Gaussian dispersion and atmospheric stability into a single dispersion element. Equation (D-7) illustrates how the Chi/Q factor is applied to an emission rate.

$$\begin{gathered}\text{Air Concentration} = \text{Chi/Q factor} \times \text{Emission Rate} \\ \text{or in units} \\ \text{mg/m3} = \text{sec/meter3} \times \text{mg emitted/sec}\end{gathered} \tag{D-7}$$

As discussed previously, the Chi/Q factor was derived using CAP-88; the wind data for the Pocatello, Idaho, airport; and the NE fence line distance of 12,000 m. As a result, the VOC dispersion estimates are based on the same relationships as the radionuclide dispersion estimates. The Chi/Q factor derived using CAP-88 for the NE wind vector is 6.2 E-8 sec/m^3. The VOC emissions in grams per second that were used to compute the fence line concentrations can be found in **bold** text in Table D-11.

Table D-11. Emissions and dispersion of volatile organic compounds from the V-Tank liquids and sludges.

VOC	Inventory (g)	Emissions (g)	**Emission Rate (g/sec)**	**Concentration at 12,000 m to the NE (mg/m^3)**
Trichloroethene	21,501	2.8	**1.6E-6**	**9.9E-11**
Tetrachloroethene	6,488	0.8	**4.9E-7**	**3.0E-11**
1,1,1-Trichloroethene	2,525	0.004	**2.1E-9**	**1.3E-13**
VOC Emission Factor = 1.3E-4				
Release duration = 60 days (1,728,000 seconds)				
Chi/Q (NE) in sec/m^3 = 6.2E-8				

An example of the VOC emission and fence line concentration estimate using TCE is provided below.

$$1.6\,\mathrm{E}-6\ \mathrm{g/sec\ emissions\ of\ TCE} = \frac{21{,}501\,\mathrm{g} \times 0.00013}{1{,}728{,}000\,\mathrm{sec}}$$

See Equation D-6

$$\frac{9.9\mathrm{E}-11\ \mathrm{mg}}{\mathrm{m3}} = \frac{1.6\mathrm{E}-6\mathrm{g}}{\mathrm{sec}} \times \frac{6.2\mathrm{E}-8\ \mathrm{sec}}{\mathrm{m3}} \times \frac{1000\,\mathrm{mg}}{\mathrm{g}}$$

See Equation D-7

Example VOC Emission and Fence Line Concentration Estimate

D-3.3.3 Estimation of Worker Exposure to VOC Concentrations

Worker exposure to VOCs arising from the V-Tanks and the processing of liquids and sludges will be assessed by estimating exposure point concentrations with a box model described by Dobbins (1979) as illustrated in Equation (D-8) and Figure D-1.

$$\mathrm{mg/m3} = \frac{\mathrm{emission\ rate\ (mg/sec)} \times \mathrm{length\ of\ wind\ path\ over\ the\ source\ area\ (m)}}{\mathrm{wind\ speed\ (m/sec)} \times \mathrm{box\ height\ (m)} \times \mathrm{source\ area\ (m2)}} \qquad \text{(D-8)}$$

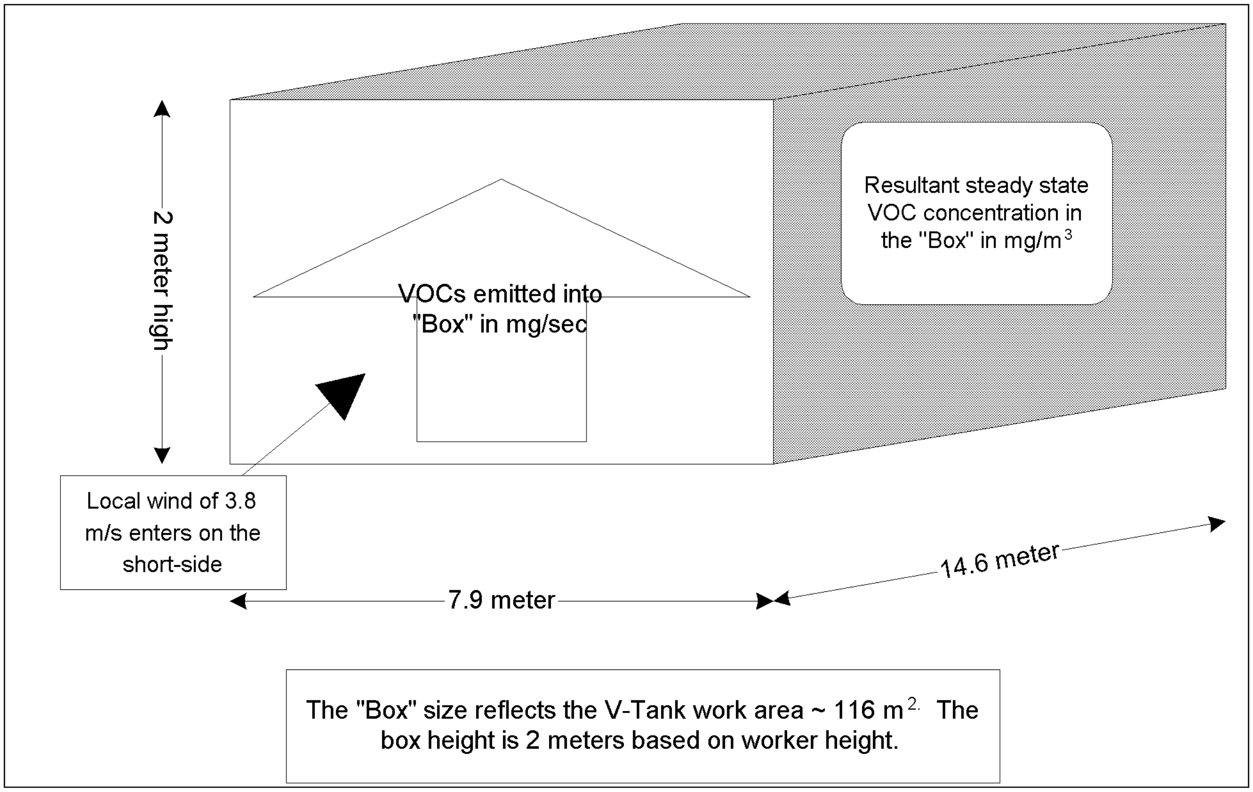

Figure D-1. Box Model for Estimating Worker Exposure Concentrations.

Worker exposure concentration estimates are provided in Table D-12.

Table D-12. Emissions and worker exposure estimates from volatile organic compounds from the V-Tank liquids and sludges.

VOC	Inventory (g)	Emissions (g)	**Emission Rate (g/sec)**	**Concentration In the Box (mg/m^3)**
Trichloroethene	21,501	2.8	**1.6E-6**	**1.5E-5**
Tetrachloroethene	6,488	0.8	**4.9E-7**	**4.5E-6**
1,1,1-Trichloroethene	2,525	0.004	**2.1E-9**	**1.9E-8**

VOC Emission Factor = 1.3E-4.

Release duration = 60 days (1,728,000 seconds).

Length of wind path over the source 7.9 meters.

Wind speed = 3.8 m/sec.

Box height = 2 m.

Area of emissions $115.3m^2 \sim 116m^2$.

(See Figure D-1).

An example of the VOC emission and worker exposure concentration estimate using TCE is provided below.

$$1.6\text{E-6 g/sec emissions of TCE} = \frac{21{,}501\,\text{g} \times 0.00013}{1{,}728{,}000\,\text{sec}}$$

See Equation D-6

$$1.5\,\text{E-5 mg/m3 TCE} = \frac{\frac{1.6\,\text{E-6}}{\text{sec}} \times 7.8\,\text{m}}{\frac{3.8\,\text{m}}{\text{sec}} \times 2\,\text{m} \times 116\,\text{m2}} \times 1000\,\text{mg/g}$$

See Equation D-8 (Note small round off difference with table value)

Example VOC Emission and Fence Line Concentration Estimate

The quantities and volumes used in the emission equations can be reviewed in Table D-13. Table D-14 contains quantities and volumes of liquids, sludges, and the sand filter. Key values are noted in **bold.**

Table D-13. Quantities and Volumes of Soils.

Source	yd^3	m^2	lb	Tons	grams
Area around Tanks and Piping	1,250	115.3	3.7E+06	1.9E+03	1.7E+09
Surrounding Controlled Area	2,200	275	6.6E+06	3.3E+03	3.0E+09
Total Controlled And EA	3,450	390	1.0E+07	5.2E+03	4.7E+09
Import Fill	500	NA	1.5E+06	7.5E+02	6.8E+08
Total All Soils Handled	**3,950**	**390**	1.2E+07	**5.9E+03**	5.4E+09

Note: 390 m^2 was used as the CAP-88 source area.

The total quantity of soil used to estimate emissions was 5,919 tons.

Soil density = 1.78 g/cc or 111 lb/ft^3.

See also Section 6 of the RD/RA WP.

D-14. Quantities and Volumes of Liquids, Sludges, and Sand Filter.

Element	Tank V-1	Tank V-2	Tank V-3	Tank V-9	Sand Filter	Total
Inventory Sludge and Liquid, gal	1.68E+03	1.60E+03	8.30E+03	3.20E+02	–	**1.19E+04**
Inventory Sludge, gal	5.20E+02	5.20E+02	6.52E+02	2.50E+02	–	1.94E+03
Inventory Liquid, gal	1.16E+03	1.08E+03	7.65E+03	7.00E+01	–	9.96E+03
Inventory Sludge, grams	**2.01E+06**	**2.01E+06**	**2.52E+06**	**9.65E+05**	–	**7.50E+06**
Inventory Liquid, grams	**4.41E+06**	**4.07E+06**	**2.89E+07**	**2.65E+05**	–	3.77E+07
Sand Filter, grams	–	–	–	–	**3.53E+04**	–
Total Sand Filter and Sludge, grams	–	–	–	–	–	**7.53E+06**
Total Sand Filter and Sludge, pounds	–	–	–	–	–	1.66E+04
Total Sand Filter and Sludge, tons	–	–	–	–	–	**8.3**
Sand Filter Contents, ft^3	**0.7**	–	–	–	–	–
Unit Conversions	–	–	–	–	–	–
Density, sludge, g/cc	1.02	–	–	–	–	–
cc/gal	3,785	–	–	–	–	–
Density, soil and sand filter shake, g/cc	1.78	–	–	–	–	–

Inventory Sludge, grams and Inventory Liquid, grams were used to estimate VOC emissions.

Total sand filter and sludge quantity of 8.3 tons (7.53E+06 grams) was used for the estimation of radionuclide emissions from the V-Tank solids.

See also Section 6 of the RD/RA WP.

D-4. REFERENCES

DOE, 1997, *CAP-88,* Version 2.0, Department of Energy, DOE-ER-8GTN-EPA, 1997.

DOE-ID, 2000a, *Comprehensive Remedial Design/Remedial Action Work Plan for the Test Area North, Operable Unit1-10, Group 1 Site,* Department of Energy Idaho Operations Office, DOE/ID-10712, Revision 0, August 2000.

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EPA, 1970, *Workbook of Atmospheric Dispersion Estimates (AP-26)*, Office of Air Programs, U.S. Environmental Protection Agency, Washington, D.C.

EPA 1998, *Compilation of Air Pollutant Emission Factors, AP-42,* Fifth Edition, Volume I: *Stationary Point and Area Sources,* Office of Air Quality Planning and Standards, January 1995 (Section 13.2.4), January 1995 (Section 4.8), and September 1998 (Section 13.2.2).

Grove Engineers, 1995, *Rad Decay*, Version 1.1.

IDAPA, 2001. Idaho Administrative Procedures Act, Requirements for Toxic Air Pollutants, Section 58.01.01, 585, and 586.

OSHA, 1997, *Regulations for General Industry*, Occupational Safety and Health Administration, 29 CFR 1910.

D-5. CAP-88 OUTPUTS

Summary CAP-88 computer outputs are presented in the following pages in this order:

- Emissions from excavation of soils in the excavation area at the V-Tanks
- Emissions from handling and transfer of sludges and filter shake at the V-Tanks
- Chi/Q derived from emissions from handling and transfer of sludges and filter shake at the V-Tanks run.

C A P 8 8 - P C

Version 2.00

Clean Air Act Assessment Package - 1988

S Y N O P S I S R E P O R T

Non-Radon Individual Assessment
Sep 26, 2001 12:02 pm

File VSOLFINA

Facility: INEEL, V-Tanks Located In Test Area North
Address: INEEL
Worst-Case Emissions from Soils
City: INEEL
State: ID Zip: 83415

Source Category: DOE Facilities
Source Type: Area
Emission Year: 2001

Comments: Emissions from Excavation of Soils in the Secured Area & AOC & Fill at the V-Tanks

Effective Dose Equivalent
(mrem/year)

6.51E-04

At This Location: 12,000 Meters Northeast

Dataset Name: V-Tank Soils Fen
Dataset Date: Sep 26, 2001 12:02 pm
Wind File: C:\CAP88PC2\WNDFILES\PIH0359.WND

MAXIMALLY EXPOSED INDIVIDUAL

Location Of The Individual: 12,000 Meters Northeast
Lifetime Fatal Cancer Risk: 1.34E-08

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Dose Equivalent (mrem/y)
GONADS	3.81E-04
BREAST	3.58E-04
R MAR	1.93E-03
LUNGS	3.06E-04
THYROID	3.71E-04
ENDOST	3.93E-03
RMNDR	3.49E-04
EFFEC	6.51E-04

RADIONUCLIDE EMISSIONS DURING THE YEAR 2001

Nuclide	Class	Size	Source #1 Ci/y	TOTAL **Ci/y**
CO-60	**Y**	**1.00**	**2.3E-05**	**2.3E-05**
CS-137	**D**	**1.00**	**2.1E-03**	**2.1E-03**
BA-137M	**D**	**1.00**	**1.9E-03**	**1.9E-03**
SR-90	**D**	**1.00**	**4.2E-03**	**4.2E-03**
Y-90	**Y**	**1.00**	**4.2E-03**	**4.2E-03**

SITE INFORMATION

Temperature: 10 degrees C
Precipitation: 89 cm/y
Mixing Height: 800 m

SOURCE INFORMATION

Source Number: 1

Source Height (m): 3.
Area (sq m): **390.**

Plume Rise
Momentum (m/s): 0.
(Exit Velocity)

AGRICULTURAL DATA

	Vegetable	Milk	Meat
Fraction Home Produced:	0.700	0.399	0.442
Fraction From Assessment Area:	0.300	0.601	0.558
Fraction Imported:	0.000	0.000	0.000

Food Arrays were not generated for this run.
Default Values used.

DISTANCES (M) USED FOR MAXIMUM INDIVIDUAL ASSESSMENT

12,000 16,000 20,000 22,000 25,000

MAXIMALLY EXPOSED INDIVIDUAL

Location Of The Individual: 12,000 Meters Northeast
Lifetime Fatal Cancer Risk: 6.99E-11

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Dose Equivalent (mrem/y)
GONADS	8.12E-07
BREAST	7.69E-07
R MAR	1.69E-05
LUNGS	6.98E-07
THYROID	7.93E-07
ENDOST	3.68E-05
RMNDR	1.07E-06
EFFEC	3.88E-06

RADIONUCLIDE EMISSIONS DURING THE YEAR 2001

Nuclide	Class	Size	Source #1 Ci/y	TOTAL Ci/y
CO-60	Y	1.00	1.1E-08	1.1E-08
CS-137	D	1.00	3.9E-06	3.9E-06
BA-137M	D	1.00	3.7E-06	3.7E-06
SR-90	D	1.00	4.2E-05	4.2E-05
Y-90	Y	1.00	4.2E-05	4.2E-05

SITE INFORMATION

Temperature: 10 degrees C
Precipitation: 89 cm/y
Mixing Height: 800 m

SOURCE INFORMATION

Source Number:	1
Source Height (m):	3.
Area (sq m):	390.
Plume Rise Momentum (m/s): (Exit Velocity)	0.

AGRICULTURAL DATA

	Vegetable	Milk	Meat
Fraction Home Produced:	0.700	0.399	0.442
Fraction From Assessment Area:	0.300	0.601	0.558
Fraction Imported:	0.000	0.000	0.000

Food Arrays were not generated for this run.
Default Values used.

DISTANCES (M) USED FOR MAXIMUM INDIVIDUAL ASSESSMENT

12,000 16,000 20,000 22,000 25,000

C A P 8 8 - P C

Version 2.00

Clean Air Act Assessment Package - 1988

File Vslgfina

S Y N O P S I S R E P O R T

Non-Radon Individual Assessment
Sep 27, 2001 04:22 am

Facility: INEEL, V-Tanks Located In Test Area North
Address: INEEL
Worst-Case Emissions Sludges
City: INEEL
State: ID Zip: 83415

Source Category: DOE Facilities
Source Type: Area
Emission Year: 2001

Comments: Emissions from Handling and Transfer of Sludges
Filter Shake at the V-Tanks

Effective Dose Equivalent
(mrem/year)

8.34E-08

At This Location: 12,000 Meters Northeast

Dataset Name: Vsludges Final
Dataset Date: Sep 27, 2001 04:22 am
Wind File: C:\CAP88PC2\WNDFILES\PIH0359.WND

MAXIMALLY EXPOSED INDIVIDUAL

Location Of The Individual: 12,000 Meters Northeast
Lifetime Fatal Cancer Risk: 1.73E-12

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Dose Equivalent (mrem/y)
GONADS	5.12E-08
BREAST	4.81E-08
R MAR	2.38E-07
LUNGS	4.13E-08
THYROID	4.99E-08
ENDOST	4.81E-07
RMNDR	4.65E-08
EFFEC	8.34E-08

RADIONUCLIDE EMISSIONS DURING THE YEAR 2001

Nuclide	Class	Size	Source #1 Ci/y	TOTAL Ci/y
CO-60	**Y**	**1.00**	**1.2E-08**	**1.2E-08**
CS-137	**D**	**1.00**	**2.8E-07**	**2.8E-07**
BA-137M	**D**	**1.00**	**2.6E-07**	**2.6E-07**
SR-90	**D**	**1.00**	**5.0E-07**	**5.0E-07**
NI-63	**W**	**1.00**	**4.1E-08**	**4.1E-08**
Y-90	**Y**	**1.00**	**5.0E-07**	**5.0E-07**

SITE INFORMATION

Temperature: 10 degrees C
Precipitation: 89 cm/y
Mixing Height: 800 m

SOURCE INFORMATION

Source Number:	1
Source Height (m):	0.
Area (sq m):	**116.**
Plume Rise Momentum (m/s): (Exit Velocity)	0.

AGRICULTURAL DATA

	Vegetable	Milk	Meat
Fraction Home Produced:	0.700	0.399	0.442
Fraction From Assessment Area:	0.300	0.601	0.558
Fraction Imported:	0.000	0.000	0.000

Food Arrays were not generated for this run.
Default Values used.

DISTANCES (M) USED FOR MAXIMUM INDIVIDUAL ASSESSMENT

12,000 16,000

C H I / Q T A B L E S

Non-Radon Individual Assessment
Sep 25, 2001 03:39 pm

File Vslgfina

Facility: INEEL, V-Tanks Located In Test Area North
Address: INEEL
Worst-Case Emissions Sludge
City: INEEL
State: ID Zip: 83415

Source Category: DOE Facilities
Source Type: Area
Emission Year: 2001

Comments: Emissions from Handling and Transfer of Sludges
Filter Shake at the V-Tanks

Dataset Name: Vsludges Final
Dataset Date: Sep 25, 2001 03:39 pm
Wind File: C:\CAP88PC2\WNDFILES\PIH0359.WND

GROUND-LEVEL CHI/Q VALUES FOR CO-60
CHI/Q TOWARD INDICATED DIRECTION (SEC/CUBIC METER)

	Distance (meters)		
Dir	12,000	16,000	
N	4.479E-08	3.011E-08	
NNW	1.592E-08	1.067E-08	
NW	1.697E-08	1.138E-08	
WNW	1.189E-08	7.928E-09	
W	2.500E-08	1.683E-08	
WSW	1.933E-08	1.299E-08	
SW	3.861E-08	2.580E-08	
SSW	2.758E-08	1.840E-08	
S	2.889E-08	1.941E-08	
SSE	1.362E-08	9.176E-09	
SE	1.707E-08	1.147E-08	
ESE	8.675E-09	5.786E-09	
E	2.022E-08	1.341E-08	
ENE	3.261E-08	2.153E-08	
NE	**6.156E-08**	4.109E-08	**Chi/Q for VOC Estimation**
NNE	5.678E-08	3.836E-08	

GROUND-LEVEL CHI/Q VALUES FOR CS-137
CHI/Q TOWARD INDICATED DIRECTION (SEC/CUBIC METER)

	Distance (meters)	
Dir	12,000	16,000
N	4.479E-08	3.011E-08
NNW	1.592E-08	1.067E-08
NW	1.697E-08	1.138E-08
WNW	1.189E-08	7.928E-09
W	2.500E-08	1.683E-08
WSW	1.933E-08	1.299E-08
SW	3.861E-08	2.580E-08
SSW	2.758E-08	1.840E-08
S	2.889E-08	1.941E-08
SSE	1.362E-08	9.176E-09
SE	1.707E-08	1.147E-08
ESE	8.675E-09	5.786E-09
E	2.022E-08	1.341E-08
ENE	3.261E-08	2.153E-08
NE	6.156E-08	4.109E-08
NNE	5.678E-08	3.836E-08

GROUND-LEVEL CHI/Q VALUES FOR BA-137M
CHI/Q TOWARD INDICATED DIRECTION (SEC/CUBIC METER)

	Distance (meters)	
Dir	12,000	16,000
N	9.280E-12	5.183E-13
NNW	2.859E-12	1.598E-13
NW	3.061E-13	9.753E-15
WNW	1.835E-13	5.874E-15
W	3.500E-13	1.134E-14
WSW	3.014E-13	9.596E-15
SW	7.665E-13	2.397E-14
SSW	6.212E-13	1.919E-14
S	4.571E-13	1.468E-14
SSE	2.137E-13	6.874E-15
SE	3.049E-13	9.673E-15
ESE	4.736E-13	1.604E-14
E	5.271E-12	2.936E-13
ENE	1.818E-11	1.195E-12
NE	8.527E-12	3.759E-13
NNE	2.606E-12	8.546E-14

GROUND-LEVEL CHI/Q VALUES FOR SR-90
CHI/Q TOWARD INDICATED DIRECTION (SEC/CUBIC METER)

	Distance (meters)	
Dir	12,000	16,000
N	4.479E-08	3.011E-08
NNW	1.592E-08	1.067E-08
NW	1.697E-08	1.138E-08
WNW	1.189E-08	7.928E-09
W	2.500E-08	1.683E-08
WSW	1.933E-08	1.299E-08
SW	3.861E-08	2.580E-08
SSW	2.758E-08	1.840E-08
S	2.889E-08	1.941E-08
SSE	1.362E-08	9.176E-09
SE	1.707E-08	1.147E-08
ESE	8.675E-09	5.786E-09
E	2.022E-08	1.341E-08
ENE	3.261E-08	2.153E-08
NE	6.156E-08	4.109E-08
NNE	5.678E-08	3.836E-08

GROUND-LEVEL CHI/Q VALUES FOR NI-63
CHI/Q TOWARD INDICATED DIRECTION (SEC/CUBIC METER)

Dir	Distance (meters)	
	12,000	16,000
N	4.479E-08	3.011E-08
NNW	1.592E-08	1.067E-08
NW	1.697E-08	1.138E-08
WNW	1.189E-08	7.928E-09
W	2.500E-08	1.683E-08
WSW	1.933E-08	1.299E-08
SW	3.861E-08	2.580E-08
SSW	2.758E-08	1.840E-08
S	2.889E-08	1.941E-08
SSE	1.362E-08	9.176E-09
SE	1.707E-08	1.147E-08
ESE	8.675E-09	5.786E-09
E	2.022E-08	1.341E-08
ENE	3.261E-08	2.153E-08
NE	6.156E-08	4.109E-08
NNE	5.678E-08	3.836E-08

GROUND-LEVEL CHI/Q VALUES FOR Y-90
CHI/Q TOWARD INDICATED DIRECTION (SEC/CUBIC METER)

	Distance (meters)	
Dir	12,000	16,000
N	4.403E-08	2.943E-08
NNW	1.560E-08	1.038E-08
NW	1.654E-08	1.100E-08
WNW	1.158E-08	7.652E-09
W	2.443E-08	1.631E-08
WSW	1.892E-08	1.263E-08
SW	3.778E-08	2.507E-08
SSW	2.698E-08	1.787E-08
S	2.827E-08	1.885E-08
SSE	1.333E-08	8.917E-09
SE	1.668E-08	1.112E-08
ESE	8.500E-09	5.630E-09
E	1.986E-08	1.309E-08
ENE	3.216E-08	2.113E-08
NE	6.063E-08	4.026E-08
NNE	5.590E-08	3.757E-08

GROUND-LEVEL CHI/Q VALUES FOR ZN-65
CHI/Q TOWARD INDICATED DIRECTION (SEC/CUBIC METER)

	Distance (meters)		
Dir	12,000	16,000	
N	4.479E-08	3.011E-08	
NNW	1.592E-08	1.067E-08	
NW	1.697E-08	1.138E-08	
WNW	1.189E-08	7.928E-09	
W	2.500E-08	1.683E-08	
WSW	1.933E-08	1.299E-08	
SW	3.861E-08	2.580E-08	
SSW	2.758E-08	1.840E-08	
S	2.889E-08	1.941E-08	
SSE	1.362E-08	9.176E-09	
SE	1.707E-08	1.147E-08	
ESE	8.675E-09	5.786E-09	
E	2.022E-08	1.341E-08	
ENE	3.261E-08	2.153E-08	
NE	**6.156E-08**	4.109E-08	CHI/Q for VOC estimates
NNE	5.678E-08	3.836E-08	

Appendix E

Quality Level Evaluation

SAFETY CATEGORY DESIGNATION AND RECORD

Safety Category Evaluation Performed By: John H. Nicklas Date: June 26, 2001

Facility/Structure/System/Component: TAN V-Tanks Hazard Category: Low

IDENTIFICATION OF ITEM	SAFETY CATEGORY DESIGNATION	TECHNICAL JUSTIFICATION
1. Office space with utilities	CG	Does not fall into any other category.
2. Hydraulic excavator	LSC	Accident scenario includes only standard industrial hazard.
2.1 Shoring -- all components	LSC	Accident scenario includes only standard industrial hazard.
2.2 Trench Boxes	LSC	Accident scenario includes only standard industrial hazard.
3. Soil sampling equipment	CG	Does not fall into any other category.
4. High Integrity Containers (HIC)	LSC	Is not estimated to result in acute worker fatality or serious injury; however, is considered in the safety analysis.
4.1 HIC for tank V-9	LSC	Fissile material is insufficient to cause a criticality.
4.2 HIC shielding	LSC	Is not estimated to result in acute worker fatality or serious injury; however, is considered in the safety analysis.
4.3 HIC tarp	CG	Does not fall into any other category.
4.4 HIC dewatering pump	LSC	Is not estimated to result in acute worker fatality or serious injury; however, is considered in the safety analysis.
4.5 Filtering equipment	LSC	Is not estimated to result in acute worker fatality or serious injury; however, is considered in the safety analysis.
5. Concrete barriers for shielding	LSC	Is not estimated to result in acute worker fatality or serious injury; however, is considered in the safety analysis.
6. Pumping system for sludge and liquid waste removal -- all components containing waste	LSC	Is not estimated to result in acute worker fatality or serious injury; however, is considered in the safety analysis.
6.1 Pumping system for sludge and liquid waste removal from Tank V-9 -- all components containing waste	LSC	Fissile material is insufficient to cause a criticality.
6.2 Pumping system for sludge and liquid waste removal -- all other components (mechanical and electrical)	LSC	Is not estimated to result in acute worker fatality or serious injury; however, is considered in the safety analysis.
6.3 Heavy walled hoses	LSC	Is not estimated to result in acute worker fatality or serious injury; however, is considered in the safety analysis.

SAFETY CATEGORY DESIGNATION AND RECORD

6.4 Sleeves or double hoses on joints and hoses	SC	Is not estimated to result in acute worker fatality or serious injury; however, is considered in the safety analysis.
6.5 Man way cover for cables and hoses	SC	Is not estimated to result in acute worker fatality or serious injury; however, is considered in the safety analysis.
6.6 Air/water sparger, sludge lance, and vibrator	SC	Is not estimated to result in acute worker fatality or serious injury; however, is considered in the safety analysis.
6.7 Remote camera and lights	SC	Is not estimated to result in acute worker fatality or serious injury; however, is considered in the safety analysis.
6.8 Remote monitoring system (process)	.SC	Is not estimated to result in acute worker fatality or serious injury; however, is considered in the safety analysis.
6.9 Bartlett Super Sleever	:G	Does not fall into any other category.
7. Crane	.SC	Accident scenario includes only standard industrial hazard.
7.1 Hoisting and lifting equipment -- all load bearing components	.SC	Accident scenario includes only standard industrial hazard.
7.2 Hoisting and lifting equipment -- all non-load bearing components	.SC	Accident scenario includes only standard industrial hazard.
7.3 Tank lifting lugs	.SC	Accident scenario includes only standard industrial hazard.
8. Drum storage and decontamination pad, including geotextile liner.	:G	Does not fall into any other category.
8.1 HIC storage and drum filling pad	:G	Does not fall into any other category.
	:G	Does not fall into any other category.
10. Radiological Control Information Management System (RCIMS)	.SC	Is not estimated to result in acute worker fatality or serious injury; however, is considered in the safety analysis.
10.1 Personnel monitoring station	.SC	Is not estimated to result in acute worker fatality or serious injury; however, is considered in the safety analysis.
11. Drainage control berms and measures	:G	Does not fall into any other category.
11.1 Culvert pipe	:G	Does not fall into any other category.
11.2 Drainpipes and raingutters	:G	Does not fall into any other category.
12. Fencing with lockable gates	:G	Does not fall into any other category.
13. Roadway with geotextile fabric	:G	Does not fall into any other category.

SAFETY CATEGORY DESIGNATION AND RECORD

14. Combustible gas meter	LSC	The safety analysis has determined that there is no safety significant equipment for this project.
15. HEPA ventilation system	LSC	Is not estimated to result in acute worker fatality or serious injury; however, is considered in the safety analysis.
16. Cement or grout	CG	Does not fall into any other category.
17. Oxygen survey meter	LSC	The safety analysis has determined that there is no safety significant equipment for this project.
18. DOT 55-gallon waste drums	LSC	This presumes that a Type B container would not be required and is classified as a QL-2 by PLN120, Revision 4. However, the safety analysis has determined that there is no safety significant equipment for this project.
19. DOT 55-gallon waste drums for tank V-9	LSC	This presumes that a Type B container would not be required and is classified as a QL-2 by PLN120, Revision 4. However, the safety analysis has determined that there is no safety significant equipment for this project.
20. Sludge drum filling system	LSC	Is not estimated to result in acute worker fatality or serious injury; however, is considered in the safety analysis.
20.1 Sludge drum filling system for tank V-9	LSC	Fissile material is insufficient to cause a criticality.
21. PPE	LSC	Is not estimated to result in acute worker fatality or serious injury; however, is considered in the safety analysis.
22. Utility locators (water, electric)	CG	Does not fall into any other category.
23. Soil bags	CG	Does not fall into any other category.
23.1 Bag lifting frame	LSC	Accident scenario includes only standard industrial hazard.
24. Foam Sealant for piping	LSC	Is not estimated to result in acute worker fatality or serious injury; however, is considered in the safety analysis.
25. Drill for pipes	LSC	Waste characterization shows there are no ignitables.
26. Saw for pipes	LSC	Waste characterization shows there are no ignitables.
27. Geotextile liner for excavation site	CG	Does not fall into any other category.
28. Heavy equipment for backfilling	CG	Does not fall into any other category.
29. Tank V-3 overflow prevention equipment	LSC	Is not estimated to result in acute worker fatality or serious injury;

SAFETY CATEGORY DESIGNATION AND RECORD

		however, is considered in the safety analysis.
30. Communication system	CG	Does not fall into any other category.
31. Excavation Barriers	CG	Does not fall into any other category.
32. DOT Shipping casks	SC (3)	This presumes that a Type B container is required and is classified as a QL-1 by PLN120, Revision 4.

Note: Identify and record safety category in accordance with MCP-540, and obtain appropriate approvals. Completed and approved form becomes a part of the safety basis documentation.

Safety Analysis Supervisor Concurrence Printed/Typed Name	Safety Analysis Supervisor Concurrence Signature	Date

Facility/Program/Project Approval Printed/Typed Name	Facility/Program/Project Approval Signature	Date

SC = Safety Class
SS = Safety Significant
LSC = Low Safety Consequence
CG = Consumer Grade

Appendix F

Remedial Action Cost Estimate

Appendix F

Remedial Action Cost Estimate

The cost estimate for the Waste Area Group (WAG) 1 Operable Unit (OU) 1-10 Group 2 Remedial Design/Remedial Action Work Plan (RD/RA WP) is presented in Table F-1. This is the cost estimate for the V-Tanks remedial action, as described in Section 6 of the Group 2 RD/RA WP. The estimated costs are provided at a summary level and include only the costs associated with the remedial design and remedial action for the V-Tanks (Sites TSF-09 and TSF-18).

The costs in Table F-1 include both direct and indirect costs. Direct costs are estimated for labor, equipment, construction, and operation activities to design and implement the selected remedy for the V-Tanks remedial action. Indirect costs are estimated for activities to support the remedial design and remedial action activities, such as project management, construction management, and project support. Although the estimated costs are projected to be within +15% and –10%, the estimated costs are based on specific assumptions related to the identified scope of work. These assumptions are identified in Section F-2.

The estimate for the V-Tanks remedial design and remedial action is based on specific scope and planned activities. Actual costs through June 2001 have been included in the estimate. The general scope description and general assumptions are provided in Section F-1. Specific cost estimate assumptions are provided in Section F-2. Detailed cost estimates can be found in the Idaho National Engineering and Environmental Laboratory (INEEL) WAG 1 Detailed Work Plan (DWP) for Fiscal Year (FY) 2001 and FY 2002 to 2004. Cost estimates contained in the DWP are more detailed, based on the more-detailed scope, assumptions, and schedule activities described in the DWP.

The estimate for V-Tanks operations and maintenance is based on scope and assumptions contained in the FY 2001 update of the INEEL WAG 1 Life Cycle Baseline. The general scope and assumptions for operations and maintenance are provided in Section F-3.

F-1. GENERAL DESCRIPTION OF V-TANKS REMEDIAL ACTION

The following sections provide brief descriptions of the scope elements for the V-Tanks remedial action. The overall scope is subdivided into the following elements:

- Remedial action management and oversight
- Remedial action preparations
- Tank contents removal and processing
- Sludge interim storage, transport, and disposal
- Tanks and ancillary piping/equipment removal
- Tanks and ancillary piping/equipment processing and disposal
- Remaining contaminated soil removal.

F-1.1 Remedial Action Management and Oversight

Remedial action management and oversight includes project management and support required for planning, executing, and monitoring the remedial design and remedial action activities.

Table F-1. Summary level cost estimate for OU 1-10 Group 2 V-Tanks.

			Subtotals	Totals
Federal Facility Agreement and Consent Order (FFA/CO) Management and Oversight				$1,708,722
	WAG 1 Project Management and Support		$1,708,722	
Remedial Design				$1,877,095
	Group 2 RD/RA WP and Supporting Documents		$1,877,095	
Post-Record of Decision Sampling				$705,985
	Tank V-9 Sampling		$705,985	
Remedial Action				$21,364,386
	Remedial Action Management and Oversight		$956,790	
	Remedial Action Preparations		$4,823,356	
	Mobilization and Site Preparations	1,863,885		
	Test Area North (TAN)-607 Preparations for Sludge Interim Storage	315,552		
	Equipment and Material Procurement	1,580,959		
	Mockup and Dry-Run Testing	764,831		
	Readiness Assessment and Prefinal Inspection	298,129		
	Tank Contents Removal and Processing		$3,795,015	
	Tank V-1, V-2, and V-3 Contents Removal	1,678,580		
	Tank V-9 Contents Removal	635,281		
	Liquid Processing and Transport to INEEL CERCLA Disposal Facility (ICDF)	975,603		
	Sludge Drumming and Placement into Interim Storage	505,551		
	Sludge Interim Storage, Transport, and Disposal		$7,540,670	
	Sludge Interim Storage at TAN-607	792,041		
	Sludge Transport to Treatment and Disposal Facility	4,929,737		

Table F-1. (continued).

		Subtotals	Totals
Sludge Off-Site Treatment and Disposal	1,818,892		
Tanks and Ancillary Piping/Equipment (TAP/E) Removal		$2,307,057	
TAP/E Removal Preparations	574,676		
Excavation and TAP/E Removal	1,138,979		
Prefinal Inspection and Report	83,884		
Contaminated Soil Transport and Disposal at ICDF	137,028		
Backfill Excavation with Clean Soil	295,490		
Site Restoration and Demobilization	77,000		
TAP/E Processing and Disposal		$1,777,275	
TAP/E Processing and Packaging	539,496		
TAP/E Transport and Off-Site Disposal	1,237,779		
Remaining Contaminated Soil Removal		$164,223	
Operations and Maintenance			$1,382,250
Institutional Controls		$338,000	
Site Maintenance and 5 Year Reviews		$994,250	
Total Estimated Cost for V-Tanks Remedial Design and Remedial Action and Operations and Maintenance			$27,038,438

F-1.2 Remedial Action Preparations

Remedial action preparations include all activities that must be completed before the actual remedial action is started. Pre-mobilization documentation will be submitted and personnel training will be completed. Materials and equipment will be procured and delivered to the site. Work control documentation will be prepared for site preparation activities.

Mobilization to the site and site preparations will be completed. Site preparations will include:

- Constructing a temporary transport road from the tank site to the adjacent temporary processing and storage areas
- Constructing the processing area for sludge dewatering and containerizing (drumming), and liquid treatment and solidification
- Constructing the temporary storage area for sludge, liquid, soil, and tanks/equipment/piping
- Establishing an onsite office
- Establishing site access controls.

Preparations will be made in TAN-607 for sludge interim storage. Preparations will include procuring secondary containment for the sludge drums, procuring and installing concrete shielding, procuring and installing video inspection equipment, and providing measures for heat and fire protection.

A mockup of the tank contents removal equipment will be assembled and tested off-Site in Idaho Falls, Idaho. Work control documentation will be prepared for tank contents-removal activities. The tank contents-removal equipment will be reassembled onsite and dry run testing will be performed.

A readiness assessment will be performed to ensure all requirements have been met, documentation is in place, personnel are properly trained, and equipment is operational for starting the tank contents removal. An Agency prefinal inspection will be performed to ensure that all documentation is in place and all requirements have been met for performing the remedial action.

F-1.3 Tank Contents Removal and Processing

Tank contents removal will be conducted in four stages. The first stage will be to remove and filter approximately 5,000 gal of supernate (liquid) from Tank V-3. The liquid will be passed through a filter train, placed in liquid high integrity containers (HICs), and transferred to the processing area.

The second stage will be to remove sludge from the bottom of Tanks V-1, V-2, and V-3. The sludge will be pumped into sludge dewatering HICs and de-watered. Liquid removed from the sludge will be returned to the tanks. Sludge HICs will be transferred to the processing area.

The third stage will be to remove the remaining liquid from Tanks V-1, V-2, and V-3. Liquid will be pumped from the tanks, passed through a filter train, placed in liquid HICs, and transferred to the processing area.

The fourth stage will be to remove sludge and liquid from Tank V-9. Sludge and liquid will be pumped into sludge dewatering HICs and dewatered. Liquid from the sludge will be passed through a filter train, placed in a liquid HIC, and transferred to the processing area. Sludge HICs will be transferred to the processing area. In the processing area, liquid will be sampled, passed through a treatment train (if necessary), and solidified in the liquid HICs. Solidified liquid will be transported to the ICDF for interim storage at the Staging and Storage Annex (SSA) and final disposal at the ICDF. Sludge will be sampled, further dewatered (if necessary), and placed in 55-gal drums. The 55-gal sludge drums will be placed into the sludge interim storage area in TAN-607.

F-1.4 Sludge Interim Storage, Transport, and Disposal

Work control documentation will be prepared for operating and maintaining the sludge interim storage area. Routine maintenance will be performed on the storage area and associated radiation monitoring equipment and video inspection equipment. Weekly inspections will be performed and documented.

Sludge drums will be packaged and transported to the off-Site treatment and disposal facility. One drum of sludge per week will be removed from interim storage, loaded into a Type B transport cask, and shipped to the off-Site treatment and disposal facility. The treatment and disposal facility will treat the sludge and dispose of residuals.

F-1.5 Tanks and Ancillary Piping/Equipment Removal

- Work control documentation will be prepared for excavation and removal of the tanks and ancillary piping/equipment. A readiness assessment will be performed to ensure readiness to begin this work.

- The sand filter and contents will be removed.

- Piping between Tanks V-1, V-2, and V-3, and Buildings TAN-616 and TAN-615 will be excavated and removed.

- Trench shielding will be installed around three sides of Tanks V-1, V-2, and V-3. The tanks will be excavated and removed, one at a time, from the north to the south.

- Piping between Tank V-9 and Building TAN-616 will be excavated and removed. Tank V-9 will be excavated and removed.

- The TAN-1704 valve box and piping running north from the valve box will be excavated and removed. (The cost of this work is not included in the V-Tanks cost estimate. This work is being covered by the INEEL Voluntary Consent Order [VCO] program.)

- All excavated tanks and ancillary piping/equipment will be transferred to the storage area for processing, sizing, and packaging. Excavated soil will be placed in soil bags and transported to the INEEL SSA for interim storage and then transferred to the ICDF for disposal.

- All soil in all areas of the excavation and in the area of contamination adjacent to the excavation will be sampled to determine the extent of the contaminated soil remaining.

- An Agency prefinal inspection will be performed to confirm that the remedial action has been satisfactorily performed for tank contents and tanks and ancillary piping/equipment removal.

- Geo-textile fabric will be placed on all excavated areas and the excavation will be backfilled with clean soil.

F-1.6 Tanks and Ancillary Piping/Equipment Processing and Disposal

- The sand filter will be processed, packaged, and transported to an off-Site facility for disposal
- Piping will be sized, processed, packaged, and transported to an off-Site facility for disposal
- Tanks will be processed and packaged in shrink-wrap material, and then transported to an off-Site facility for disposal
- Secondary waste, resulting from the remedial action activities, will be packaged and transported to an off-Site facility for treatment and/or disposal.

F-1.7 Remaining Contaminated Soil Removal

- The remaining contaminated soil at the V-Tanks site will be excavated and transported to the ICDF for disposal.
- The excavation will be backfilled with clean soil and the entire site will be restored. Institutional control signage will be placed at the site.
- An Agency final inspection will be performed to confirm that all remedial action has been satisfactorily performed at the V-Tanks site. A final inspection report will be prepared and submitted to the Agencies documenting the results of the final inspection.

F-2. COST ESTIMATE ASSUMPTIONS

The cost estimate presented in Table F-1 is based on the following assumptions. These assumptions have been divided into the categories of key assumptions, general assumptions, and task-specific assumptions.

F-2.1 Key Assumptions

- Tank V-9 is assumed to not pose a criticality concern, which will be confirmed with the results of Tank V-9 sampling and the subsequent criticality evaluation.
- The V-Tanks are assumed to have never leaked. All soil contamination at the site is assumed to be due to surface spills.

F-2.2 General Assumptions

- The cost estimate is based on the remedial design approach presented in this Group 2 V-Tanks RD/RA WP.
- The Group 2 V-Tanks RD/RA WP will become final in November 2001.

- An "Explanation of Significant Differences" addressing the design approach for sludge/liquid separation and liquid filtration/treatment will be prepared and issued by November 2001.

- A change in design approach to separate liquid and sludge was made during the early stages of the design to reduce the volume of V-Tank contents requiring interim storage on-Site and treatment and disposal off-Site at the planned treatment and disposal facility, Allied Technology Group (ATG). The change in design approach provides significant cost savings by reducing the volume of tank contents waste that must be sent to ATG for treatment and disposal. The cost estimate includes approximately $3 million for liquid/sludge separation that has not been fully negotiated and formally added to the V-Tanks RD/RA subcontractor's scope.

- Sufficient funding is available to support the schedule and planned performance of the work.

- Sufficient facility-supplied resources (Radiological Engineering, Industrial Hygiene, radiological control technician, etc.) will be available at TAN to support the V-Tanks remedial action work.

- A current labor issue (a grievance filed in February 2001 by the PACE Union) will not affect the current plan for all work to be performed by the RD/RA subcontractor.

- No significant decontamination and dismantlement (D&D) activities for Building TAN-616, requiring interface and coordination with the V-Tanks remedial action, will occur during FYs 2002 and 2003.

- VCO program funding and documentation will be in place to support the removal of the VCO TAN-1704 valve box and piping concurrent with the removal of Tank V-9.

- Work involving tank contents (liquid and sludge) has been planned to be performed in non-freezing weather conditions. The design of the contents removal system and equipment does not include provisions for freeze protection.

- Results from Tank V-9 sampling will be available and a criticality analysis will be performed in a timely manner and will not pose a constraint on the schedule for Tank V-9 contents removal.

- Although a contingency plan is included in the Group 2 V-Tanks RD/RA WP for continued increase of the liquid level in Tank V-3, the contingency plan will not be required and is not currently addressed in this cost estimate.

- The estimate of volumes for the V-Tanks is 2,000 gal of sludge and 10,000 gal of liquid is accurate.

- The planned treatment and disposal facility for V-Tanks sludge, ATG, will be operational and available to accept waste in the spring of 2002. ATG will accept the V-Tank sludge at a rate that will require interim storage of sludge at the INEEL for no more than 2 years.

- V-Tank sludge will be placed into interim storage in the TAN-607 warm shop pending shipment for off-Site treatment and disposal. Modifications and preparations of the TAN-607 warm shop will be completed, and the interim storage area will be ready to accept sludge by April 30, 2002.

- Approximately 2,000 yd^3 of contaminated soil will be excavated to remove the V-Tanks and ancillary piping/equipment.

- Approximately 1,000 additional yards of contaminated soil at the V-Tanks site will be excavated in FY 2004 to complete the remedial action for the V-Tanks site (TSF-09 and TSF-18).

- The ICDF will be operational in July 2003 for disposal of V-Tank waste streams that meet the ICDF's Waste Acceptance Criteria (WAC). The SSA, associated with the ICDF, is currently open and available for receipt and interim storage of V-Tank waste streams that meet the SSA's WAC.

- The cost for interim storage and final disposal at the SSA and ICDF is covered by the WAG 3 project. There will be no cost to WAG 1 for interim storage and final disposal at the SSA and ICDF.

- Work control measures for all work described in this work package will be implemented through STD-101, "Integrated Work Control Process," rather than through Conduct of Operations and MCP-3562, "Hazard Identification, Analysis, and Control of Operational Activities."

- Separate STD-101 work controls will be prepared for site preparations, tank contents removal, and tanks and ancillary piping/equipment removal. Work control for site preparations will be less rigorous than that required for the two remedial action tasks.

- A Level 1 Readiness Assessment will be required in accordance with MCP-2783, "Startup and Restart of Nuclear Facilities," prior to the start of tank contents removal. A higher-level readiness assessment will not be required. The startup authority will be the TAN Site Area Director. An independent Department of Energy Idaho Operations Office review will not be required. The readiness assessment will be performed after site preparations are complete and the on-Site removal system dry run/system operational testing has been performed.

- A Management Self-Assessment (MSA) will be required prior to the start of Tank V-9 contents removal. The startup authority will be the TAN Site Area Director. The MSA will be in addition to the Level 1 Readiness Assessment and will be used to verify removal system and equipment setup and readiness for the Tank V-9 contents removal.

- A MSA will be required prior to the start of contaminated soil excavations and tanks and ancillary piping/equipment removal. The startup authority will be the TAN Site Area Director.

F-2.3 Assumptions for TAN-607 Warm Shop Preparations for V-Tanks Sludge Storage

- The TAN-607 facility will not require structural modifications.

- Concrete shielding blocks ($2 \times 2 \times 6$-ft concrete blocks) configured to a height of 6 ft meet the shielding requirements as identified in the INEEL *Radiological Control Manual* and provide protection in accordance with as low as reasonably achievable (ALARA) goals.

- Electronic surveillance equipment is available "off the shelf."

- Any electronic surveillance equipment conveyance system would be a "specialty item" and will require engineering.

- The floor loading will be suitable for installation of shielding blocks.

- Drum containment pallets will be provided and utilized for secondary containment of sludge containers and can be moved/transported on-Site with a forklift capable of lifting 4 drums/pallet.

- Radiological monitoring equipment will be available and maintained by the facility tenant manager.

- Facility configuration will be in compliance with the TAN Operations Safety Analysis Report.

- Any portion of the work scope that falls under Davis-Bacon provisions will be performed by INEEL force account construction craft.

- An assessment, to determine that the TAN-607 preparations are complete and ready for receipt of V-Tanks sludge, will be performed as part of the readiness assessment for start of V-Tank contents removal.

F-2.4 Assumptions for Tanks V-1, V-2, V-3 and V-9 Contents Removal

- Existing tank contents sample data are representative of the physical properties of the sludge and the contamination to be encountered in all media.

- Tank sludge has not hardened to a cement-like form. The sludge can be suspended in water by mechanical action or low intensity shear forces.

- Liquid/sludge separation will occur during tank contents removal using a sludge dewatering HIC.

- Liquid will be filtered and treated during tank contents removal and placed in HICs.

F-2.5 Assumptions for Tank Contents Waste Processing and Disposal

- Tank sludge will be further dewatered and containerized (drummed) at the tank contents processing area.

- Tank sludge drums will be transferred to and placed in the sludge interim storage area in TAN-607.

- Liquid will be further treated and then solidified in HICs at the tank contents processing area

- Only one batch process of liquid treatment will be required for liquid to be able to meet land disposal restrictions and the SSA's WAC.

- Solidified liquid will be transported and off-loaded into interim storage at the SSA.

F-2.6 Assumptions for Soil Excavation and TAP/E Removal

- Tanks are constructed of 1/4-in. thick stainless steel and the structural integrity is intact.

- Piping to be removed is stainless steel and the structural integrity is intact.

- No groundwater will be encountered during tank, piping, or contaminated soil excavation.

- Equipment with fixed contamination (Model D-5 Caterpillar, track hoe, and front-end loader) will be available from the D&D program as Government Furnished Equipment for use by the RD/RA subcontractor for performing excavation work.

- The tops of Tanks V-1, V-2, and V-3 are approximately 10 ft below ground surface. The depth of the excavation to the bottom of the tanks is approximately 20 ft below ground surface.

- The top of Tank V-9 is approximately 7 ft below ground surface. The depth of the excavation to the bottom of the tank is approximately 14 ft below ground surface.

- Excavated contaminated soil will be placed in bins and shipped to Envirocare for disposal. (A change is currently being planned to transport the contaminated soil to the SSA for interim storage and final disposal at the ICDF.)

F-2.7 Assumptions for V-Tanks Sludge Interim Storage, Treatment, and Disposal

- The off-Site Treatment, Storage, and Disposal Facility (TSDF) will be accepting waste for treatment in late FY 2002

- Criticality concerns and other similar issues will not prevent the performance of the identified scope

- A total of 100 drums will be generated and placed in interim storage

- One drum/week will be shipped off-Site for treatment and disposal

- Shipment cycle time will be 2 weeks per cask

- The TSDF will be responsible for cask loading/unloading at their job site

- Treatment and disposal at the off-Site TSDF will be performed under a fixed price contract

- Current estimated cost for treatment and disposal is based on price quotes from ATG to WAG 5 for similar waste (ARA-16 sludge)

- Transportation and TSDF companies are “pre-qualified” on the INEEL Vendor List

- TAN-607 will be in existence and in an “operable” condition with existing services (i.e., electrical, water, sewer, life safety, heating, ventilating, and air conditioning) during sludge interim storage duration

- Sludge drums will provide leak-tight storage for 2 years and include vents

- Shipping casks will be available and on-Site for use

- The TAN-607 overhead crane will be available and maintained in an operational readiness condition

- Casks will be loaded with a mobile crane
- The mobile crane and necessary fixtures will be available, provided and maintained by WESTON
- Container surveillance will be performed by a remote and mechanized video inspection system
- Configuration as conceived and planned for interim storage will meet all operational requirements.

F-2.8 Assumptions for V-Tanks Site Contaminated Soil Remedial Action

- Shoring installed during the V-Tank removal will have to be removed.
- The extent of contaminated soil removal will be determined based on sampling performed during V-Tank removal.
- 1,000 yd^3 of contaminated soil will be removed and will be disposed of at the ICDF.
- The ICDF will be open in July 2003. INEEL operations (PACE) crafts will perform contaminated soil removal and clean soil backfill.

F-3. OPERATIONS AND MAINTENANCE

The cost estimate presented in Table F-1 for V-Tanks operations and maintenance has been extracted from the OU 1-10 cost estimate contained in the FY 2001 update of the INEEL WAG 1 Life Cycle Baseline. In this estimate, operations and maintenance are assumed to be required for 97 years (from 2001 to 2098).

The cost for V-Tank operations and maintenance was determined by dividing the total operations and maintenance cost for OU 1-10 into the four primary remedial action sites. The four sites are the V-Tanks, the PM-2A Tanks, the radiologically contaminated soil sites, and the Burn Pit sites.

The scope of the operations and maintenance for the V-Tanks includes the following:

- Inspection and maintenance of institutional controls
- General site inspection and maintenance
- Five-year reviews.

F-4. REFERENCES

INEEL, 1994, *Safety Analysis Report for Test Area North Operations at the Idaho National Engineering Laboratory*, Idaho National Engineering and Environmental Laboratory, INEL-94/0163, September 1996.

MCP-2783, March 2000, "Startup and Restart of Nuclear Facilities," Rev. 3, Operations.

MCP-3562, April 2001, "Hazard Identification, Analysis, and Control of Operations Activities," Rev. 3. Operations.

STD-101, September 2001, "Integrated Work Control Process," Rev. 12, Operations.